A Review of Cloud Computing for the Evolution of the E-Learning Process

Akanksh Reddy Muddam[1], Lavanya Reddy Satti[2]

[1]Student, Computer Science and Engineering, Sree Dattha Institute of Engineering and Science
Email: *akanksh2511[at]gmail.com*

[2]Faculty, Computer Science Department, St. Joseph's Degree & PG College
Email: *lavanyareddysatti[at]gmail.com*

Abstract: ***Online communication platforms are used to facilitate e-learning, a type of virtualized computing, and remote learning as a tool in the teaching-learning process. In the last two years, e-learning platforms have grown significantly. When the learning process is digitized, data mining for education information processing leverages information generated from internet databases to improve the educational learning paradigm for educational purposes. A potential platform for enabling e-learning systems is cloud computing. It may be automatically changed by offering a scalable solution for the long-term transformation of computer resource use. When engaging with large e-learning datasets, it is also easier to employ data mining techniques in a distributed setting.***

Keywords: E-Learning, Cloud Computing, Virtual Learning, SaaS, PaaS, IaaS

1. Introduction

Due to the extensive use of the internet, other digital communication systems, and remote learning, e-learning has evolved. It uses a variety of forms and features that might be most helpful for classroom instruction. These include, among other things, online courses, emails with links to websites, discussion forums, and other platforms for learning. The learning process is better managed as a result of the online integration of students, content creators, and specialists. The most notable advantages of learning with web-based tools are the tasks' regularity and recurrence, customization, accessibility, and easier access. In information technology (IT), e-learning or virtual education platforms are growing in popularity, especially in light of the Covid-19 outbreak and technological development. Numerous institutions throughout the world have incorporated Massive Open Online Courses (MOOCs), Blackboard, Desire to Learn (D2L), and the Virtual Learning Center as part of their global E-learning initiatives. Virtual programmes, which are completely supported by the e-learning paradigm and offer a clear optimal learning environment in comparison to traditional attendance classes, are used significantly more frequently for students who may access their course materials online [5]. Numerous effects are a result of these ratios, including, for instance, the infrastructure needed to support that many students concurrently would be considerably beyond what users of standard online applications could handle. Additionally, the demand for educational resources frequently changes quickly and dynamically, with notable activity surges. A far more sophisticated infrastructure will be needed than what is typically needed for the educational institution to operate regularly at certain times to respond to requests without interfering with other system services. One approach is to offer services based on consumption and charge only for resources that are used under a pay-per-use model. Technology based on cloud computing offers a solution to these issues. The original goal of cloud computing was to lower computational expenses while boosting system availability and dependability [1, 7]. Since then, cloud computing has grown to achieve these objectives. However, there is a difference between the two in terms of how the tasks are determined in each environment [9]. A computing grid is more reliable in terms of technological resources and is primarily made to increase a computer system's performance. In contrast, cloud computing seeks to offer transparent mobility while letting consumers purchase various services without becoming familiar with the fundamental infrastructure. It offers a wide variety of services, such as hosting and word processing.

This kind of technology is meant to assist programmers in overcoming a variety of dispersed organisational computing barriers, including application integration, concurrency control, and security protocols, as well as a wide range of other systems and protocols, the use of hardware and software to which we may be directly exposed, and existing data systems. A cloud platform's whole feature set is made available while keeping customers' access to the location and other technical details of the computing infrastructure hidden [10]. The benefits of this new computing paradigm are obvious when compared to competing for technology. Because cloud software companies strive to deliver equivalent or better capabilities and functions than if the applications were loaded locally on end-user workstations, users don't have to spend money on new hardware to use the application. Because it instantly intends the business needs by interactively assigning IT assets (servers) based on the computation complexity in virtual environments, this storage capacity and computing initiatives assist corporations to get their software fully operational faster, with a lesser provision of services from the IT division.

Large archives of student interaction with classmates and teachers are also produced by expansive e-learning settings, like those previously outlined. These systems include significant data that hasn't been declared openly. Data mining algorithms are required [6]. In this circumstance, educational data mining (EDM) is a strategy that aids both teachers and students in improving instruction and learning. This field focuses on developing new approaches for analysing the data produced by the aforementioned present educational system activity. The ultimate goal of this approach is to better analyse student performance and develop procedures and tools that will make learning more enjoyable and simple. Computer-based tutoring programmes have been created with this approach in mind to support the teaching and learning process. The EDM process interacts with an educational model, extending and improving the information it already contains. Cloud hosting is a step toward adopting data mining algorithms and putting them into practice for every database, taking into account the size and capacity expansion of computer capabilities (solid space, ram, and CPUs) [4]. On the other hand, a few other data mining techniques aren't extremely scalable. Scholars and corporations alike are taking note of this topic since it is becoming so important.

Because of the Covid-19 pandemic, educational institutions all across the world are switching to blended learning or full-on online courses. The main difficulty is delivering safe and sufficient resources to assist the E-learning process. The goal of this study is to analyse cloud computing services for e-learning so that teachers can take use of their scalability, flexibility, and security to support and improve e-learning. The rest of this essay is structured as follows. The basic concepts of cloud computing are introduced in Section 2, E-learning tasks and cloud computing are covered in Section 3, and perspective challenges of e-learning and cloud computing are covered in Section 4. Section 5 brings the paper to a close.

1) Essential Concepts in Cloud Computing

The reviews of cloud computing are contained in each of the analyses in the sections above. The review's foundation in qualitative analysis enables academics to elaborate on the idea. To answer a research question, a literature review studies books, articles, and other source materials on a certain topic, field of study, or idea. It also offers a summary, synopsis, and analysis of the research subject. Cloud computing is known as using the internet to supply various resources and services such as data storage, servers, databases, networking, and software. This brings us to the idea of SOA [8], a framework for integration that combines a technological and rational framework to help and include a wide range of facilities. In the cloud computing environment, service essentially refers to a function that has been wrapped up in a form that might be mechanised and provided to clients in a consistent and organised manner. Any component that is related to hardware, such as storage space or processing speed, or software components designed to handle mail delivery, user authentication, database management, or operating system control can be viewed as a service.

In essence, the cloud computing philosophy proposes a change in the way problems are solved using technology. Designing applications starts with utilising and mixing services. The provision of functioning focuses on the utilisation and integration of services rather than the idea of processor algorithms, as with more traditional methods, such as distributed systems. This is advantageous regarding adaptability, dependability, scalability, and other factors. For instance, multiple instances of a particular service could be started so that, in the event of a spike in resource requirements brought on by an increase in users or a surge in computational load, the response time of the application remains adequate for users.

Resources should be made available as a result of a drop in demand. Everything is done in a customer-friendly manner. The least amount of connection, high level of interoperability, and protocols that separate the provider's execution and environment are some of the most significant aspects of cloud computing [9]. An SOA frequently divides its processes into levels or layers (rather than in precise boundaries). Some components use the services provided by lower tiers to make upper-tier capabilities possible. In addition, these divisions could use different corporate structures, architectural layouts, etc. There are typically three fundamental sorts of layers that come together to make what is referred to as an arrangement, depending on the kind being given. Generally speaking, there are three different sorts of coatings, including what is referred to be a cloud-based storage system that offers data storage based on "files" or "blocks. " A compute cloud is made out of several registers, columns, or other entities that provide services and give full execution capabilities. The cloud computing model is advantageous for large-scale projects [8]. It is commonly known that many corporate and scientific applications have high computing needs. Since processing enormous volumes of data stored in stable systems needs a high level of communication link, a continual data flow also suggests a large quantity of storage space.

Several categories can be used to organise service-oriented systems. One frequently used characteristic for classifying these systems is the complexity level that they offer to the system user. This approach usually distinguishes between three different levels.

The phrase "Infrastructure as a Service" (IaaS) refers to the provision of infrastructure, such as computer systems, data centres, networks, memory, and processing [6]. The software and computer programme collectively stand in for the IaaS as compared to a mono-computer platform. The operating system controls and facilitates access to the system resources. The IaaS customer leases computer resources from the IaaS provider rather than purchasing and setting up its whole computing infrastructure. The customer only pays for what they use because services are often charged based on actual usage. Because of the dynamic scalability of cloud computing, they use (and pay for) fewer resources when the workload is low. IaaS can make them available where there is a more pressing need for assistance to satisfy the needs of that particular client. Most service agreements include a top dollar amount that customers are not allowed to exceed. Scientific researchers and practitioners are a good illustration of a typical IaaS customer. Due to the IaaS and the substantial infrastructure, it offers as a service, these clients can plan experiments and analyse data to a degree that would not be possible otherwise. One of the most well-liked providers of IaaS nowadays is Amazon's Elastic Computer Cloud (EC2). IaaS service providers like

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RackSpace, Google Compute Engine, and Windows Azure are also well-known.

Platform as a Service (PaaS), which is the second level, is a provider-provided infrastructure that consists of an integrated software package with all the tools a development hub needs to build apps during the design and delivery stages [7]. Although PaaS providers do not explicitly supply infrastructure, using IaaS services gives developers the resources they need to have an indirect connection to the IaaS infrastructure and, consequently, the architecture they need [7]. The PaaS can be thought of as a "software layer, " allowing components for apps and whole apps to be created on top of it. Throughout the whole software development lifecycle, engineers can work on software bugs using a networked developer setup or a variety of standalone tools. Similarly to this, it is feasible to deploy the same programme on several systems without having to modify any code thanks to a computer language that utilises a variety of operating system compilers and modules. Google App Engine, Amazon Web Services, Heroku, OpenShift-Red Hat, and others are notable instances of PaaS-cloud computing service industry participants.

Software as a Service (SaaS) is the pinnacle of the early adoption of cloud computing when internet usage was on the rise [8]. Some companies made available to everyone the applications that appeared to be customer interaction management from the host functionalities of the Platform as a Service [4]. There are currently a lot of solutions available for education, corporations, and private citizens. The direct sharing of data in this way does not protect its confidentiality even though these services are provided over the internet, which permits geographic flexibility. Because they make it possible to send data over the internet in an encrypted format, VPNs are widely used to keep user and SaaS data secure.

2) Cloud Computing and E-Learning Tasks

Due to the suspension of on-campus classes, the enormous growth in the number of students, instructional content, services offered, and materials made accessible, e-learning systems are advancing at an exponential rate [5]. It's crucial to pick a platform that can expand to accommodate demand while limiting costs and streamlining resource processing, storage, and communication needs. The transport and retrieval of information and content in this case is a sort of cloud computing. Comparing current "cloud" learning settings to prior "conventional" learning environments might help us better understand the benefits of cloud computing, particularly on a technological and pedagogical level. We should provide the "road" for assisting migration to such a model to achieve a good system for online tools and interactive services, such as teaching materials, recordings, educational resources, peer instruction, and so forth.

Cloud computing is currently widely used in educational institutions, and it is clear that it has a bright future [4]. Initiatives like JISC (2012) are in place in several nations, including the UK, to integrate an education cloud with the necessary tools to handle and store the data. A cloud-based e-learning platform that enables users to take advantage of cloud computing is referred to as an education SaaS. Its low hardware requirements allow for quick deployment by the end user. Additionally, it frees up the provider from system support and maintenance duties, allowing the manufacturer to concentrate on the most important aspects of their business while still receiving free automated upgrades and supplying necessary resources via Web 2.0.

From a technology perspective in education, e-learning system design and cloud computing platforms are essential to the coherence, harmony, efficient use of resources, and long-term stability of the e-learning ecology [6]. The author’s summary of the effects and implications of creating e-learning solutions for the cloud computing system can be found in [7]. Because the application may be accessed from anywhere, at any time, there is initially a greater need for web development skills. Due to not having to pay for software, deployment, or server management, the subscriber has saved money as a result. As a result, the institution will spend less overall, deploy more quickly, and employ fewer IT personnel. This will be equally useful in circumstances like Coivd-19 where time is of the essence [4]. It is reasonable for the programme-type education sector to pay for content consumption so that more complex programmes and necessary applications can access it. A SaaS server can be used by numerous educational institutions. Because the system is hosted on a cloud server, scalability is already integrated into the design. The software's performance won't suffer from increased student usage. The SaaS supplier needs a sophisticated level of security to win over customers' trust and supply users with comprehensive system software. There is a greater need for platforms and data integrators for education since customer data is distributed across several services and must be combined to give a complete view of the business. Specific scholars have previously examined the benefits of cloud-based education from a technology perspective. Although cost is the most frequently mentioned issue, there are additional factors to take into account, such as those raised for cloud usage in general. Using a hard disc to back up and transfer data across devices is not required. By accumulating knowledge, pupils can keep it for as long as they like and it will continue to develop them. In this case, it seems almost wholly unnecessary to recover after a collision. If the user machine fails, almost no information is lost. Students can access their files and make changes to them while working from other locations thanks to virtualized applications, which have also lately assisted universities in implementing E-Learning, particularly during the lockout. It provides academic institutions with a barely more cost-effective option for their faculty, staff, and students.

The idea that only one place must be controlled rather than hundreds of computers scattered across a greater territory makes data access monitoring easier. A single database for all users in the cloud also makes it possible to review and implement cyber security changes quickly. Thus, even though more research is needed to ascertain how cloud-related pedagogies or assessments of learning purposes [3] will affect learning outcomes, from a scholarly perspective, one benefit of the cloud is its accessibility [4], as it was primarily designed to allow users to collaborate from anywhere at any time. Outside of the typical classroom setting, it can reach more students and satisfy their needs. It can offer more insightful information to a wider number of pupils in a wider variety of circumstances [3]. Figure 2 illustrates the characteristics of cloud computing in e-learning.

A virtualized platform is used as the top layer, followed by a cloud management system and services layer, which make up the majority of cloud e-learning methodologies. A C pool with a thin client and a server pool running the hypervisor with the private cloud architecture built using vSphere are the two computer pools used for teaching. Using a web browser, all hosts and services of the virtual infrastructure are instantly visible and manageable. Along with saving alarm data and authorization settings, monitoring things like efficiency and configuration is possible.

A single hardware host hypervisor is necessary to support several operating systems. A hypervisor allows resources to each component as they are needed, preventing virtual computers from interfering with one another. The preferable choice in this scenario is a hypervisor that operates directly on the underlying hardware. This layer meets the demands of PaaS and SaaS cloud consumers and acts as an interface to the outside world. The instructional coordinators assemble the virtual computers, select the basic images and then install the desired software [6]. As a result, for certain course projects, standard web technologies are created, and students can connect to the corresponding VM utilising the distant network.

Due to the increased demand for continuing education, schools are paying more attention to the integration of cloud technologies and e-learning. Almost all educational institutions considered it to be a viable and appropriate substitute for e-Learning. However, the lack of research might offer a theoretical base on which a technique could be built. On the other hand, the inherent flexibility of the cloud concept may have been emphasised as a significant benefit in developing an analytical framework and effective teaching methods [8]. Few research in this sector offers a strategic or tactical analysis of the topic, which is a negative.

On the other hand, the general properties of the cloud are linked in the literature to collaborative learning and social engagement. The authors of [3] look into how students perceive responsibility and the quality of various forms of Google Docs interaction. technology-enhanced teaching strategies that change and enhance the experience that students have working together to complete a group project. You can compare the outcomes of online models to traditional approaches using a variety of cloud-related studies.

3) Perspective Difficulties in Education and Cloud Computing

With today's cloud computing, applications, and capabilities, e-learning could become a very profitable sector [1, 2]. The inadequacies of traditional local physical labs and computing platforms can be significantly improved with the help of a cloud-based e-learning system. However, before the cloud can be widely used and embraced to facilitate and promote e-learning, basic issues and obstacles must be removed.

For academic institutions to effectively adopt cloud computing for e-learning and teaching, instructors and students must go through a learning curve and receive IT support. Use current public or commercial cloud resources or services, third-party solutions, or both as you see fit. To determine the optimal cloud model for the needs of the class, the instructor should also speak with the university's IT department and be well-versed in cloud capabilities. The setup, assignment, and management of cloud resources and student accounts must be taught to the instructor. Additionally, it is necessary to mentor and train students on how to access and utilise cloud-based course resources. The learning curve for instructors and students may be challenging or simple, depending on the course's requirements and design. Faculty in some disciplines, such as computer science and associated courses, can find it simpler to understand and use the cloud than faculty in other disciplines.

A cloud-based system incorporates the built-in benefits of cloud computing into e-learning, including cost savings, fault tolerance, improved accessibility, and distant connectivity. With adequate pre-implementation planning, the advantages of cloud technology can be exploited [3, 4, 5]. Any of the methods below can be used by businesses to transition from their current e-learning system to cloud-based e-learning. The conversion of an e-learning programme entails several processes, including the implementation of the server and client modules as well as the installation of the operating system and middleware. User requirements, the availability of the current IT infrastructure, and a cost/benefit analysis are all required in a migration feasibility assessment. The financial cost of a system can be kept low by effectively allocating current resources to the cloud-tiered architecture while minimising resource underutilization.

A poor internet connection can greatly hinder cloud-based education and e-learning, even if connectivity and speed have increased significantly over the past ten years to an acceptable level globally. When data and services are accessed from non-regional cloud data centres, the problem is made worse. Users and students using cloud-based e-learning systems may experience significant delays as a result of this issue. If students must use specialised software, equipment, and resources in actual labs, the cloud may not be the best platform for teaching certain topics and disciplines [8]. Robotics, mainboards, physical network devices, and digital forensics can all be categorised as equipment if a hardware dongle is needed. Although it might not be feasible in all circumstances, it is conceivable to use the cloud in part for this purpose. For such subjects, the utilisation of cloud power needs to be carefully examined and studied. The solution to this issue might lie in tools that closely resemble the hardware environment. The hybrid cloud approach should include using both on-and off-cloud resources and software.

2. Conclusion

According to the overview provided in the analysis, using cloud services for e-learning is a good alternative because it enables teachers to take advantage of the adaptability, flexibility, and security of the cloud to represent the main framework of e-learning — instruction that is accessible from any location, at any time, and using any device. We can fully take advantage of the benefits it offers when an effective learning environment with specialised material is simple to adapt to the educational paradigm used today. An e-learning system can be integrated into the cloud to benefit from increased storage, processing power, and network access, to name a few benefits. Prioritizing software and hardware reductions is necessary. In comparison, it offers a wider array of fantastic educational options for a lower licence fee. However, because of the extended machine life, the replacement rate for student computers is lower. The reduction in IT personnel expenditures related to software updates and computer lab upkeep has a positive impact on these savings.

When it comes to individualised and customised learning experiences for each user, today's e-learning services and systems fall short. This technique results in students receiving generic e-learning that is not tailored to their needs. For cloud-based personalised learning to be used and developed across many subject areas, new research and development are needed. The contact between instructors and students is essential in the majority of contemporary systems to improve the standard of each student's educational experience. Online and real-time training should allow for the integration of cloud-based e-learning services like video conferencing and instant messaging. By utilising email, voice-over-IP, and apps like Skype, contemporary cloud-based e-learning systems make up for these deficiencies. This is still a risk for the vast majority of cloud-hosted services. When determining a problem's scale, there are many things to take into account. Due to client worries about security and privacy, cloud service providers have made large investments in cloud infrastructure and platforms. Furthermore, country limits are necessary because several nations require that data be maintained within their borders, making remote data storage or storage outside of the country illegally. The current research indicates that there is a wealth of information available to academics to support the creation of cloud-based e-learning frameworks and implementations. Future research will involve a quantitative assessment of the effects of moving to a cloud-based e-learning environment on a variety of factors, including access speed, influence on educational quality, and return.

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